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Makoto NISHIDA*: **Dichotomy of vascular system in the stalk of Ophioglossaceae.** (Studies on the systematic position and constitution of Pteridophyta—2)

西田 誠*: ハナヤスリ科の所謂柄における維管束系の二叉分枝. (羊齒植物の分類學的位置及構成の研究—2)

In the previous report on the dichotomy of vascular system in the stalk of two species of *Ophioglossum*, the writer reached the conclusion that the dichotomy in this genus is homologous with that in *Botrychium*, though considerably sympodialized and vestigeal regarding the anastomozation of bundles (Nishida, 1952). Standing on the same point of view he considered the dichotomous character in all the genera and subgenera of Ophioglossaceae ever published, and could know that the manner of dichotomy in each of them is characteristically in accordance with respective position in classification. Thus he proposes to add this character of vascular dichotomy in describing the family Ophioglossaceae, as is shown below, following the system of Clausen (1938).

I. **Botrychium**

a) Subgen. Eubotrychium

Shows typical dichotomy which Nodzu (1950) calls "eu-dichotomy", sympodialization being almost not found in II[1] and III. The adaxial half of vascular bundles results from III exclusively and runs into the fertile segment (Fig. 1).

b) Subgen. Sceptridium

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1) I, II, and III denote 1st, 2nd and 3rd dichotomy respectively.

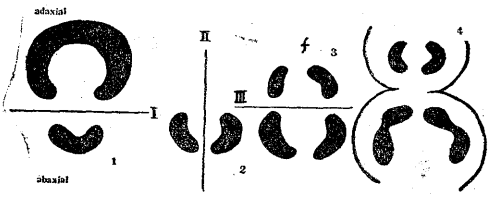

Fig. 1 Eubotrychium. *Bot. matricariaefolium* **(Chrysler 1945) I: 1st dichotmy; II: 2nd dichotmy; III: 3rd dichotmy.**

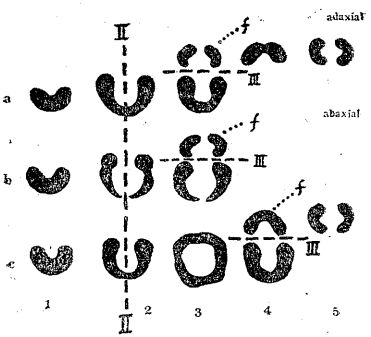

Fig. 2 Sceptridium. *Bot. japonicum* **(Nodzu 1950) a: Double-arc type; b: Singl-arc type; c: Ring type.**

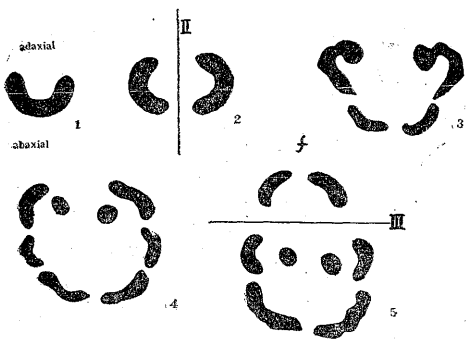

Fig. 3 Osmundopteris *Bot. virginianum* **II, III……dichotomy.**

Three types (Chrysler, 1945; Nodzu, 1950) are found with II, which sometimes is vestigeal. More or less sympodializing tendencies of III is found (Fig. 2). Rarely the vascular supply of the fertile segment comes out through the "extra-marginal method" (Bower, 1926; Chrysler, 1945), but no division of bundles occurs before III.

c) Subgen. Osmundopteris

Considerable sympodialization is found in III, which always occurs with "extra-marginal method", which is preceded by other divisions, as III begins not immediately after II (Fig. 3).

II. **Helminthostachys**

This genus shows the same behaviour of the vascular system as in Subgen. Osmundopteris of *Botrychium* (Fig. 4).

III. **Ophioglossum**

a) Subgen. Rhizoglossum

Each of fertile and sterile segments (blades) shoots off independently from the rhizome, and no common stalk is formed, making no dichotomy as discussed by the writer.

b) Subgen. Euophioglossum

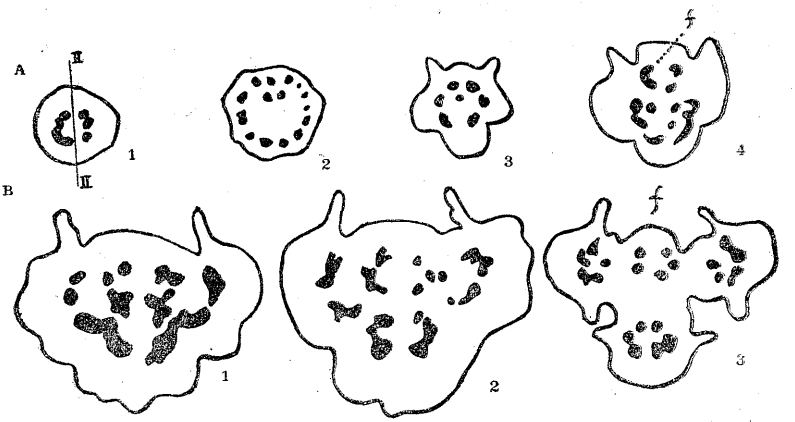

Fig. 4 Helminthostachys *H. zeylanica*
A: from Campbell (1911) B: from Farmer & Freeman (1889)
f: fertile part. II: 2nd dichotomy.

The dichotomies (II & III) are vestigeal, and extremely sympodialize. It is difficult to follow them up as the anastomozation is inserted between II and III. Apparently III occurs in a plane parallel to that of II (Fig.5 & Nishida, 1952).

c) Subgen. Ophioderma

Type of the branching in this subgenus is more complicated than the ellipticum-type (Nishida, 1952 d. Fig. 6).

Petry (1914) said on *Ophioglossum pendulum*, "····the vascular supply of the leaf consist of 3-12 strands, the number varying with the size of the leaf

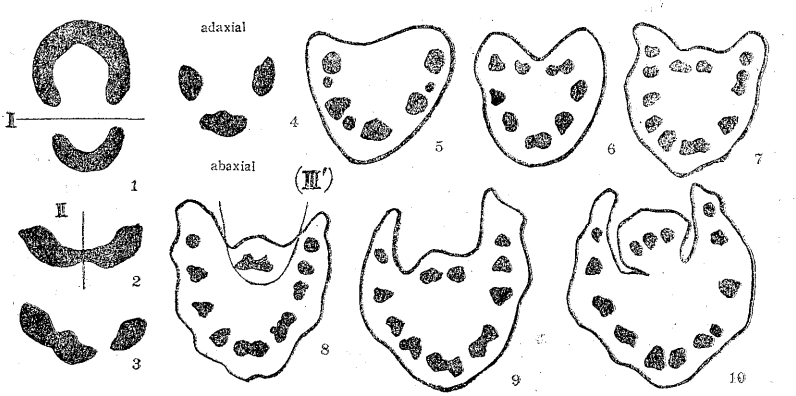

Fig. 5 Euophioglossum *O. vulgatum*
I, II·····1st, 2nd dichotomy, (III')·····presumable 3rd dichotomy.

base, and these strands form a cylindrical network in the petiole;····". In this species, three strands are found already at the first branching, and they increase in number as ascend the petiole (stalk), finally reaching 13 in all, and making up a clear "network". Even the vestige of II, which is always found in Euophioglossum, can not be seen in this subgenus, even I being preceded by anastomozation of strands (bundles).

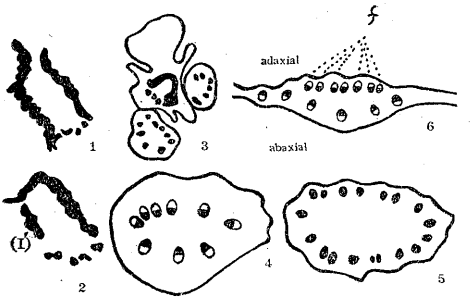

Fig. 6 Ophioderma *O. pendulum*
1 & 2. from Petry (1914) 3 ···6. from Troll (1933) (I'): presumable 1st dichotomy.

This will be natural in *Ophioderma*, for its lamina is extended in length and also in width, and the stalk (petiole) diminished to short. But the vascular strands, which are arranged cylindrically in the stalk, make two rows, upper and lower in the basal part of the lamina. And, as Petrey's observation (1914) that "···· in the lower portion of the blade, they constitute two series of strands with xylem oppositely directed, and the strand with xylem abaxially directed forms the vascular supply of the spike", the vascular bundles which run into the fertile segment are those which had protoxylem on the abaxial side, namely, they are those of the adaxial (upper) row (Fig. 6).

Although the vascular bundle is subdivided into numerous strands, the dichotomy being disturbed by excessive anastomozation after I, the branching will be understood as a complex modification of "ellipticum-type", if we call our attention to behaviours of some groups of the numerous strands. All the vascular bundles of the adaxial (upper) row, which may be presumably regarded as resulting from III, run into the fertile segment (Fig. 6).

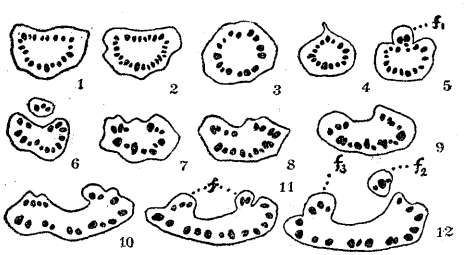

Fig. 7 Cheiroglossa *O. palmatum* (Bower 1904) f: fertile part.

d) Subgen. Cheiroglossa

As in *Ophioderma*, the anastomozation in this spec-

ies is extremely complicated, and no dichotomous character is seen at all. Several fertile segments arise, and the adaxial half of the vascular strands, which appear to be resulted from presumable III, run into both fertile and sterile segments alternately each after another (Fig .7).

Description as above is illustrated in Fig. 8 diagrammatically. Black parts of the vascular bundles show fertile supplies and their size, though roug hly, in relation to the whole. Cross lines divide four dimensions and the longitudinal lines show II. As for Ophioderma and Cheiroglossa of which III could not be pursued, the dimensions where the writer assumed that III would occur, are indicated by broken lines, and, as II is also obscure, its dimensions are put in parentheses. The shaded portion on the diagram of Sceptridum means that the "extra-marginal method" is found sometimes (Ex. *Bot. multifidum* in Chrysler, 1945).

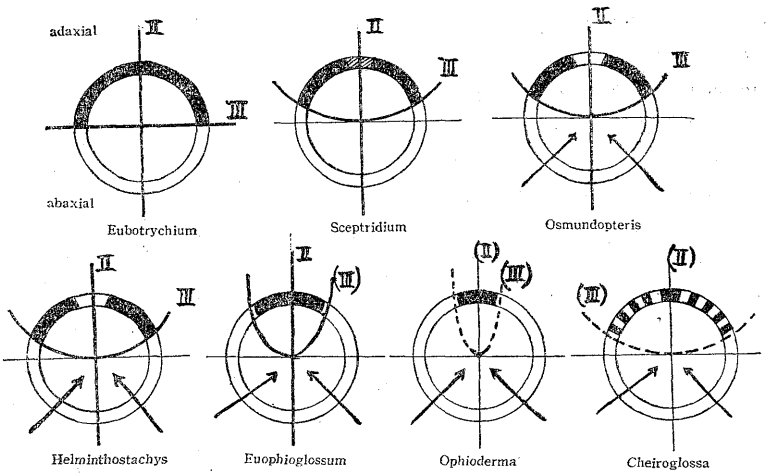

Fig. 8 Diagrams of the fertile and sterile supplies of vascular bundles in each subgenera. Arrow: division before III.

The writer agrees with Maekawa (1948) who maintained that the dichotomies of the vascular system found in the leaf petiole and the peduncle of *Ginkgo* might be regarded as homologous to that of *Botrychium* observed by Chrysler (1945), and he also likes to extend this homology, after exact observations and reasonable considerations, to *Ophioglossum.*

As for the common stalk of *Ophioglossum,* hence, as in the case of *Botrychium* as well, it may not be concluded simply that it is "petiole", but may be applied to "mesome" which Zimmermann (1938) named that in Urpteridophyta,

especially those belonging to Rhyniaceae as "··· füge nun als neue Bezeichnung den Ausdruck "Mesome" für die prinzipiell ähnlich gebauten "Internodien" zwischen je zwei Gabestellen ein···". Bower (1935) and Wettstein (1924) doubt whether the application of this conception could be extended to complex organs of seed plants, but in some organs of primitive cormophyta of today it seems to be remaining somewhat typically. If we approve Chrysler's opinion that the dichotomous character of the vascular system found in Ophioglossaceae should be regarded as resulting phylogenetically from Rhyniaceae, we shall have to conclude that each of the fertile and sterile segments of *Ophioglossum* represents a "telome" and a derived telome respectively, and that the common stalk, from which they shoot off, represents a "mesome" and a derived mesome. As for the anastomozation of the vascular system in *Ophioglossum* the writer may assume that these are resulted not from the network formed by the union of many strands each one with another, but from split of the bundle which are enlarged and pressed. Hence, the areolae of *Ophioglossum* are originated from the "crevices" of the spreading bundle in the telome. Therefore the writer will regard both fertile and sterile segments (blades) of *Ophioglossum* as "telome" or its derivative, and he may agree, in conception, with Nodzu (1950) who proposed "phyllomophore" in *Botrychium*.

Aknowlegement

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Summary

1. Dichotomous character of the vascular system in the stalk of Ophioglossaceae is characteristic in accordance with each respective genus or subgenus.

2. The common stalk of Ophioglossaceae, especially of *Ophioglossum*, is presumably derived from "mesome", and may not be socalled petiole but may be looked upon as a "phyllomophore"-like organ.

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1. ハナヤスリ科の葉柄（共通柄）内の維管束系に見られる二叉分枝は，各属及び各亜属で夫々の特徴を示している。従つてこの二叉分枝性をハナヤスリ科の分類の新標識として採用することが出來るであろう。

2. ハナヤスリ屬ではこの二叉分枝性は維管束が網狀なるために，惑亂されその追跡は不可能であるが然し，亜屬 Euophioglossum では第2回二叉分枝までは痕跡的にではあるが確認し得る。

3. ハナヤスリ屬の實葉片及び裸葉片は夫々一つの telome (Zimmermann 1930) より由來するものであり，その維管束（恐らく原生中心柱であろう）が壓し擴げられ，大きくなるにつれて，割れ目を生じ，結果として網狀脈になつたものと考える。従つてハナヤスリ屬の共通柄は，Zimmermann (1938) が，原始シダ植物に對して名付けた mesome に相當する器官であろう。こゝに筆者は野津 (1950) がハナワラビの共通柄に名付けた phyllomophore の概念をハナヤスリ科全般におしひろめたいと思う。